INFANT FEEDING AND HIV

Towards a new policy and implementation plan for minimising postnatal HIV transmission and maximising infant HIV-free survival

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Recent studies on antiretroviral prophylaxis during breastfeeding show that maternal highly active antiretroviral therapy (HAART) (alone or with 1, 4 or 24 weeks' infant prophylaxis) or infant prophylaxis alone for 6, 14 or 24 weeks (with limited maternal prophylaxis) reduces HIV transmission through breastmilk (postnatal transmission). Maternal postnatal regimens appear to be as efficacious as infant postnatal regimens, although one study shows a trend favouring infant nevirapine over maternal HAART (both used from 1 week to 6 months after delivery). These new findings necessitate a review of existing interventions to prevent mother-to-child transmission of HIV (PMTCT) , and the immediate implementation of regimens that reduce postnatal transmission – where this is feasible – to save children's lives.

In the public sector, while stakeholders engage in discussions about which is the best regimen to minimise postnatal transmission, **SSSUPPORT** should be given to all HIV-positive women to improve infant outcomes and reduce postnatal transmission, as follows: **Screen** all women for HIV, **Send** off CD4 cell counts on all HIV-positive women, **Screen** all HIV-positive women for AFASS using a standardised tool (e.g. Table II/Fig. 2 below); **Understand** the woman's personal and socio-cultural context; **Promote** exclusive or predominant breastfeeding if all AFASS criteria are not met; **Promote** exclusive formula feeding if all AFASS criteria are met; **Organise** supplies of formula milk and co-trimoxazole; **Review** mothers and infants in the first 3 days after delivery, in the first 2 weeks postnatally, and monthly thereafter, and review health and feeding practices, regardless of feeding choice, at every visit; lastly **Treat** all pregnant women with HAART if they meet national criteria for HAART initiation.

In resource-limited settings, infant feeding is the weakest link in programmes to prevent mother-to-child transmission of HIV. Although new perinatal HIV infections have been almost eliminated in resource-rich settings, elimination of new paediatric infections remains elusive in resource-limited settings, where HIV transmission through breastmilk accounts for approximately 40% of new infections.[1] Over the past 5 years, rigorously designed research, using varied study designs, has increased our knowledge about HIV transmission through breastmilk almost exponentially. However, implementing these findings has lagged far behind. A review of data shows that challenges to implementing current policies on infant feeding and HIV can be categorised into four main areas: (*i*) health care provider confusion about infant feeding and the risks of HIV transmission through breastfeeding;[2,3] (*ii*) poor support for infant feeding counsellors – qualitative research from Tanzania revealed a high level of stress and frustration among nurse counsellors, who were confused about the appropriateness of infant feeding

options in the context of HIV;[4] (*iii*) poor counselling skills[5,6] – in three South African sites, structured observations of 22 counsellors and exit interviews with 60 mothers attending prevention of mother-to-child transmission (PMTCT) clinics showed that only 2 of 34 (5.9%) HIV-positive mothers were asked about essential conditions for safe formula feeding during counselling on infant feeding options, and fewer than a quarter of mothers expressed confidence in implementing their feeding decisions;[6] and (*iv*) a disjunction between feeding recommendations and the socio-cultural context within which feeding occurs[4,7-11] – in South Africa exclusive feeding practices recommended by current guidelines are not practised unless intense support is provided,[10-12] and in Tanzania nurse counsellors perceived both exclusive breastfeeding (EBF) and exclusive formula feeding as culturally and socially unacceptable, and therefore expressed a lack of confidence in their ability to counsel about HIV and infant feeding.[4]

This paper aims to contribute to the debate on how postnatal HIV transmission can best be minimised,

and how current recommendations on HIV and infant feeding can be implemented, in a southern African context. The paper is divided into three sections: the first provides a historical overview of infant feeding in the context of HIV (for readers new to the field of infant feeding and HIV), summarises new research on postnatal prophylaxis, and discusses the implications thereof; the second section summarises existing international and national recommendations on HIV and infant feeding; and the third section focuses on how we can implement existing, and possibly new, feeding recommendations in the context of HIV.

HISTORICAL OVERVIEW OF INFANT FEEDING IN THE CONTEXT OF HIV, AND IMPLICATIONS OF RECENT FINDINGS

Table I summarises the key studies that have contributed towards the body of knowledge on HIV and infant feeding.

The recent groundbreaking studies on maternal or infant prophylaxis during breastfeeding (Table I)[13-19] yield data that should prompt immediate action and a review of existing guidelines on infant feeding and HIV. However, as highlighted by Mofenson,[20] the perfect regimen to minimise postnatal HIV transmission through breastmilk is still difficult to identify as studies have major differences. These include differences in antepartum antiretroviral drug administration and duration, the duration of prophylaxis during breastfeeding, maternal CD4 cell counts at study entry, and rates of EBF. Mofenson also points out that several studies do not specify breastfeeding duration, and hence the time at risk for postnatal HIV transmission, while others do not provide infant HIV status at birth, making it difficult to compare the incremental benefit of antiretroviral prophylaxis during breastfeeding.[20]

Despite these differences, the main message from recent studies on prophylaxis during breastfeeding is that maternal highly active antiretroviral therapy (HAART) alone[16] or with 1 week,[14] 4 weeks[18] or 24 weeks of infant prophylaxis,[13] or infant prophylaxis alone (with limited maternal prophylaxis – i.e. no HAART) for 6 weeks,[19] 14 weeks[17] or 24 weeks,[15] reduces postnatal HIV transmission (i.e. breastmilk transmission). Maternal postnatal regimens appear to be just as efficacious as infant postnatal regimens, although the Breastfeeding, Antiretroviral and Nutrition (BAN) study suggests that at 28 weeks there was a trend favouring infant nevirapine over maternal HAART (both used from 1 week to 6 months after delivery).[13] The Post Exposure Prophylaxis to the Infant (PEPI) study showed that, when risk factors were adjusted for (maternal CD4 cell count, maternal presentation, sex of infant and infant birth weight), 9-month HIV-free survival was higher among infants who received 14 weeks' postnatal prophylaxis compared with control infants who only received 1 week's antiretroviral (ARV) cover (Table I).[17] Both the PEPI and Six Week Extended Dose Nevirapine (SWEN) studies show that the protective effect of infant postnatal prophylactic ARV regimens on breastmilk HIV transmission stops once the regimens stop being taken.[17,19]

IMPLICATIONS OF RECENT FINDINGS

These messages suggest that any of the new regimens highlighted in Table I could be implemented without further delay among breastfeeding HIV-positive mothers to reduce transmission where the human resource, financial and socio-cultural capacity exists to do this, e.g. in private sector facilities, despite the inherent inequity in this approach. Even one new paediatric infection is one too many! The ideal regimen for a national public health policy still needs to be decided upon, and should be guided by data. The choice is between prophylactic maternal HAART antenatally and thoughout breastfeeding, similar to regimens used in Kesho Bora[14] or MITRA-Plus[16] (Table I), a modified BAN regimen (Table I) with maternal dual prophylaxis (modified BAN) with or without tail cover and infant nevirapine for 6 months,[13] or a modified SWEN[19] or PEPI[17] regimen, with better maternal prophylaxis and nevirapine for 6 - 14 weeks. For women who start HAART for their own health antenatally, there is currently little debate about the postnatal regimen as HAART will continue postnatally and will consequently cover the breastfeeding period if the mother breastfeeds.

For resource-limited public health settings or countries, including South Africa, that are seeking to minimise postnatal HIV transmission, three main issues need to be considered when deciding on which ARV regimen to include in a national policy: (*i*) the basic science: efficacy and possible effectiveness of various postnatal prophylactic regimens using HIV transmission and HIV-free survival as the main outcomes; (*ii*) the feasibility of each regimen from a user perspective, i.e. for pregnant women, for mothers who may need treatment after delivery, and for infants who may need treatment after delivery; and (*iii*) feasibility of each regimen from a health system/service perspective, including cost, cost-benefit, procurement, packaging and delivery systems. Work needs to be undertaken urgently to examine the issues raised above, so that appropriate, effective and feasible new regimens that minimise postnatal HIV transmission can be instituted in the public health system without further delay.

It is likely that the most appropriate policy for postnatal prophylaxis would be one that starts early, ensures that mothers who need HAART for their own health receive treatment early, ensures that the postnatal regimen would not compromise any subsequent treatment needed by mother or infant (by increasing resistance, thus decreasing maternal treatment options), is feasible from a health system and community perspective, and is cost-
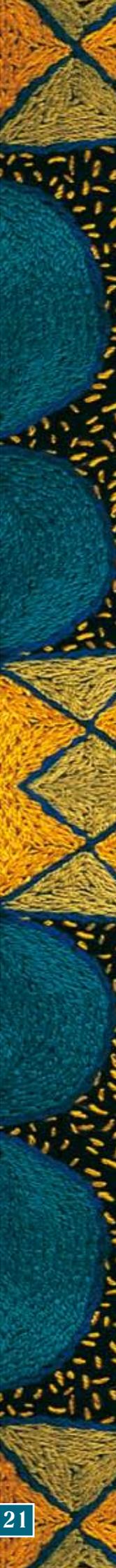
TABLE I. KEY STUDIES THAT HAVE CONTRIBUTED TO THE BODY OF KNOWLEDGE ON HIV AND INFANT FEEDING

Year, author, setting, study design, and characteristics of population	Regimens		Results and major contribution
	Mother	Baby	
1997 Ekpini *et al.*[36] Abidjan POC All BF	None	None	HIV transmission rate till 6 months: 28% (19 - 39%) for children born to HIV-1-infected women and 18% (9 - 30%) for children born to HIV-2-infected women. HIV transmission rates after 6 months for HIV-1- and HIV-2-infected women: 12% (3 - 23%) and 6% (0 - 14%), respectively, adjusting for loss to follow-up. **Main messages: The risk of transmission continues throughout the BF period. Early cessation of BF at 6 months of age is a possible intervention to reduce postnatal HIV transmission**
1999 Miotti *et al.*[37] Malawi POC All BF	None	None	7% of the 672 infants became HIV infected while BF. No infant became HIV positive after BF had stopped. The cumulative risk of infection for infants continuing to BF after 1 month to the end of months 5, 11, 17, and 23 was 3.5%, 7%, 8.9% and 10.3%, respectively. However, HIV infection rates per person per month were 0.7% in months 1 - 5, 0.6% in months 6 - 11, 0.3% in months 12 - 17, and 0.2% in months 18 - 23 (p=0.01), suggesting that HIV transmission decreases significantly as the child gets older. **Main messages: Breastmilk transmission continues throughout the BF period, but decreases as the child gets older, and stops when BF stops**
1999 Semba *et al.*[38] Blantyre, Malawi POC All BF	None	None	Mothers of HIV-infected infants have significantly greater breastmilk viral load than mothers of uninfected infants. Mastitis – probably as a result of poor BF technique – and breastmilk viral load were independently associated with MTCT of HIV-1 at 6 months (OR 2.38, 95% CI 1.26 - 4.42, and OR 2.97, 95% CI 1.23 - 7.18, respectively). **Main messages: Higher breastmilk viral load increases transmission risk through breastmilk. Mastitis also increases risk of HIV transmission, independently of breastmilk viral load**
2001 Nduati *et al.*[39] Nairobi, Kenya RCT Women randomised to BF or FF (clean water available and formula subsidised)	None	None	The cumulative probability of HIV-1 infection at 23 months was 36.7% (95% CI 29.4 - 44%) in the BF arm and 20.5% (95% CI 14 - 27%) in the formula feeding arm, p=0.001. The estimated rate of transmission (excess risk of transmission) was 16.2% (95% CI 6.5 - 25.9%). 44% of HIV-1 infection was attributable to breastmilk. Kaplan-Meier estimates of the 2-year mortality rate were similar in the BF arm (24.4% (95% CI 18.2 - 30.7%) and formula feeding arm (20.0% (95% CI 14.4 - 25.6%)), p=0.30. The 2-year HIV-free survival rate was significantly lower in the BF arm (58%) compared with the formula feeding arm (70%), p=0.02. **Main messages: Most breastmilk transmission seemed to occur early during BF; however, transmission risk difference continued to increase throughout the BF period. HIV-free survival at 2 years was better in the formula feeding arm**

Year, author, setting, study design, and characteristics of population	Regimens		Results and major contribution
	Mother	**Baby**	
2001 Coutsoudis et al.[24] Cato Manor – urban area, South Africa Unexpected findings from a vitamin A RCT Women self-selected to EBF or EFF	None	None	Cumulative probabilities of HIV detection were similar among never and exclusive breastfeeders up to 6 months (0.19, 95% CI 0.14 - 0.26 and 0.19, 95% CI 0.13 - 0.27, respectively). Probabilities among mixed breastfeeders surpassed both groups, reaching 0.26 (95% CI 0.21 - 0.32) by 6 months Cumulative probability of HIV infection by 15 months was 0.25 (95% CI 0.16 - 0.34). This was still lower than among other breastfeeders – 0.36 (95% CI 0.27 - 0.45). In multivariate analysis EBF was associated with a significantly lower risk of HIV infection (adjusted HR 0.56, 95% CI 0.22 - 1.42) than mixed BF (adjusted HR 0.87, 95% CI 0.33 - 2.33) **Main messages: Pattern of infant feeding affects transmission; EBF was associated with a lower risk of HIV transmission than mixed feeding**
2003 Richardson et al.[40] Nairobi, Kenya Prospective RCT Nested case control study within RCT of BF and FF	None	None	Mother's CD4 count <400/µl was associated with 3-fold higher breastmilk infectivity per litre of breastmilk ingested and per day of BF by the infant compared with CD4 cell count ≥400 **Main messages: Breastmilk infectivity remains high throughout the BF period. Lowering breastmilk viral load during BF is a potential strategy to reduce breastmilk infectivity**
2004 BHITS study group[41] Meta-analysis, 9 randomised placebo-controlled trials	None	None	Overall estimated risk of late postnatal (negative at or before 4 weeks followed by positive results) HIV transmission was 8.9 transmissions per 100 child-years of BF The cumulative probability of late postnatal transmission at 18 months was 9.3% **Main messages: Cases of postnatal transmission continued to occur throughout the BF period. Breastmilk transmission remained fairly constant throughout the BF period**
2005 Illiff et al.[25] Zimbabwe RCT Mothers randomised to 1 of 4 vitamin A treatment groups All mothers BF	None	None	Compared with EBF, early mixed feeding was associated with a 4.03 (95% CI 0.98 - 16.61), 3.79 (95% CI 1.40 - 10.29) and 2.60 (95% CI 1.21 - 5.55) greater risk of postnatal HIV transmission at 6, 12 and 18 months, respectively Predominant BF was associated with a 2.63 (95% CI 0.59 - 11.66), 2.69 (95% CI 0.95 - 7.63, and 1.61 (95% CI 0.72 - 3.64) trend towards greater postnatal transmission risk at 6, 12 and 18 months, respectively, compared with EBF **Main messages: EBF was associated with a lower risk of HIV transmission compared with mixed feeding. Predominant BF also tended to carry higher risks of transmission compared with EBF**
2006 MASHI study[30] Botswana RCT	AZT for 6 months FF	BF Infant AZT	**Main messages: FF was associated with significantly higher rates of infant mortality and severe pneumonia and diarrhoea by 6 months, particularly among HIV-infected children 24-month HIV-free survival did not differ between arms** With the exception of grade 3/4 pneumonia and in the context of weaning at 6 months by the BF arm, differences by feeding arm were attenuated by 24 months

TABLE I. KEY STUDIES THAT HAVE CONTRIBUTED TO THE BODY OF KNOWLEDGE ON HIV AND INFANT FEEDING (CONTINUED)

Year, author, setting, study design, and characteristics of population	Regimens		Results and major contribution
	Mother	**Baby**	
2007 Coovadia *et al.*[23] Hlabisa – rural area, South Africa POC AFASS-guided feeding	Sd NVP	Sd NVP	14.1% (95% CI 12.0 - 16.4) of exclusively BF infants were infected with HIV-1 by age 6 weeks and 19.5% (17.0 - 22.4) by 6 months Transmission risk was significantly associated with maternal CD4 cell counts below 200 cells/µl (adjusted HR 3.79; 2.35 - 6.12) and birth weight less than 2 500 g (1.81, 1.07 - 3.06). Kaplan-Meier estimated risk of acquisition of infection at 6 months of age was 4.04% (2.29 - 5.76) BF infants who also received solids were significantly more likely than EBF children to acquire infection (HR 10.87, 1.51 - 78.00, *p*=0.018), as were infants who at 12 weeks received both breast-milk and formula milk (1.82, 0.98 - 3.36, *p*=0.057) Cumulative 3-month mortality in EBF infants was 6.1% (4.74 - 7.92) v. 15.1% (7.63 - 28.73) in infants given replacement feeds (HR 2.06, 1.00 - 4.27, *p*=0.051) **Main messages: Early introduction of solids increased transmission risks, as did mixed feeding. 3-month mortality was highest in infants receiving no breastmilk compared with infants who were EBF; low maternal CD4 cell count increased risk of infant HIV acquisition**
2007 Kuhn *et al.* (ZEBS)[26] Zambia Epidemiological study nested within a RCT evaluating the safety and efficacy of early weaning	Sd NVP	Sd NVP	Postnatal HIV transmission before 4 months was significantly lower (*p*=0.004) among EBF (0.040, 95% CI 0.024 - 0.055) than non-EBF infants (0.102, 95% CI 0.047 - 0.157); time-dependent relative hazard (RH) of transmission due to non-EBF = 3.48 (95% CI 1.71 - 7.08) There were no significant differences in the severity of disease between EBF and non-EBF mothers, and the association remained significant (RH=2.68, 95% CI 1.28 - 5.62) after adjusting for maternal CD4 count, plasma viral load, syphilis screening results and low birth weight **Main messages: Non-EBF more than doubles the risk of early postnatal (by 4 months) HIV transmission. Early cessation of breastfeeding increases morbidity and mortality risks**
2008 SWEN[19] Ethiopia, Uganda and India 3 similar RCTs All BF	**C:** sd NVP **Int:** sd NVP	**C:** sd NVP **Int:** sd NVP + extended daily NVP until 6 weeks	There was a 46% decrease in postnatal HIV infection at age 6 weeks in infants uninfected at birth, with extended nevirapine compared with the control arm. There was a continued risk of postnatal HIV transmission after the regimens were discontinued in infants who continued to be breastfed; however this risk was similar in both arms **Main messages: Postnatal infant NVP for 6 weeks reduced transmission compared with sd NVP, and improved 6-month HIV-free survival. Transmission risk continued after NVP was stopped**
2008 Post Exposure Prophylaxis to the Infant (PEPI) trial[17] Malawi RCT All BF	**C:** sd NVP **Int 1:** sd NVP **Int 2:** sd NVP	**C:** sd NVP + 1 week AZT **Int 1:** sdNVP + 14 weeks daily NVP **Int 2:** sd NVP + 14 weeks NVP and AZT	At 9 months, the estimated rate of HIV-1 infection (the primary end-point) was 10.6% in the control group compared with 5.2% in the extended-nevirapine group (*p*<0.001) and 6.4% in the extended-dual-prophylaxis group (*p*=0.002). There were no significant differences between the two extended-prophylaxis groups. There was a continued risk of postnatal HIV transmission after the regimens were discontinued in infants who continued to be breastfed; however this risk was similar in both arms **Main messages: Extended prophylaxis with NVP or with NVP and AZT for the first 14 weeks of life significantly reduced postnatal HIV-1 infection in 9-month-old infants. 9-month HIV-free survival was higher among infants who received 14 weeks' postnatal prophylaxis compared with control infants who only received 1 week's ARV cover (adjusted HR=0.001 for the 14-week postnatal infant NVP prophylaxis group, and adjusted HR=0.004 for the 14-week postnatal infant NVP + AZT prophylaxis group – both compared with control)**

Year, author, setting, study design, and characteristics of population	Regimens		Results and major contribution
	Mother	Baby	
2008 MITRA study[15] Dar es Salaam, Tanzania POC All BF	AZT/3TC to mothers from 36 weeks' gestation to 1 week postpartum	AZT/3TC to infants for 1 week followed by daily 3TC to infants for a maximum of 6 months	Cumulative HIV transmission was 3.8% at 6 weeks and 4.9% at 6 months of age. The risk of postnatal infection from 6 weeks to 6 months was 1.1% **Main messages: Infant prophylaxis for 6 months resulted in a low risk of HIV transmission through breastmilk**
2009 Kesho Bora[14] 5 sites in Burkina Faso, Kenya and South Africa HIV-infected women with CD4 200 - 500 cells/µl randomised RCT All BF	**C:** AZT started 28 - 36 weeks + sd NVP at labour + 1 week PN AZT/3TC **Int:** HAART started 28 - 36 weeks preg. through 6 months postpartum	sd NVP + 1 week AZT in both arms	The rates of HIV infection at birth were similar in both arms: 1.8% in the HAART arm versus 2.2% in short-course AZT arm At age 6 months cumulative HIV infection rates were 4.9% in the maternal HAART arm, compared with 8.5% in the short-course AZT arm Between 6 weeks and 6 months the postnatal infection rate was 1.6% in the maternal HAART arm compared with 3.7% in the short-course AZT arm without extended prophylaxis The rate of infection after the prophylaxis/HAART was discontinued was similar in both arms **Main messages: A maternal HAART arm was more efficacious than short–course regimens**
2009 Mma Bana[18] Botswana RCT HIV-infected pregnant women with CD4 cell counts >200 cells/µl were randomised. RCT All BF	**Int 1:** triple nucleoside HAART regimen **Int 2:** protease inhibitor-containing HAART regimen started 26 - 34 weeks through 6 months of BF	Sd NVP + 4 weeks AZT	Rates of viral suppression at delivery and during breastfeeding were similar between the 2 HAART regimens. The cumulative infant HIV infection rate at age 6 months was 1% (95% CI 0.5 - 2%) with only 2 infections (0.4% transmission) in 553 infants with no difference between the 2 arms **Main messages: Maternal HAART regimens were efficacious in reducing postnatal transmission in mothers with CD4 cell count >200 cells/µl**
2009 MITRA plus[16] Dar es Salaam, Tanzania POC All BF	HAART to pregnant women starting at 34 weeks and continuing through 6 months of breastfeeding		Cumulative risk of HIV infection was 5% at 6 months and 6% at 18 months of age. The risk of postnatal infection between 6 weeks and 6 months was only 1% **Main messages: Maternal HAART during BF reduced postnatal transmission through breastmilk**
2009 Breastfeeding, Antiretrovirals and Nutrition (BAN) study[13] Malawi RCT Women with CD4 cell counts >250 cells/µl at delivery and no previous antenatal prophylaxis	**C:** intrapartum sd NVP + 1 week AZT/3TC **Int 1:** C regimen + HAART from 1 week till 6 months postpartum **Int 2:** C regimen	**C:** sd NVP + 1 week AZT/3TC **Int 2:** daily infant NVP from 1 week to 6 months postpartum	The cumulative probability of HIV infection at age 6 months in infants uninfected with HIV at birth was 6.4% in the control arm, 3.0% in the maternal HAART arm (*p*=0.0032 v. controls), and 1.8% in the infant NVP arm (*p*<0.001 v. control arm). The rates were not statistically different between the 2 intervention arms, although the study was not powered to detect a difference between the arms **Main messages: Maternal HAART for 6 months and infant NVP for 6 months were equally efficacious in reducing postnatal HIV transmission through breastmilk at 6 months, although the data suggest a trend favouring infant NVP from 1 to 6 months over maternal HAART from 1 week to 6 months (*p*=0.0698)**

POC = prospective observational study; RCT = randomised controlled trial; CC = case control study; C = control group; Int = intervention group; BF = breastfeeding; FF = formula feeding; EBF = exclusive breastfeeding; EFF = exclusive formula feeding; NVP = nevirapine; AZT = zidovudine; 3TC = lamivudine; Sd = single-dose.

beneficial and supported by exclusive or predominant breastfeeding to maximise infant HIV-free survival.

One of the current gaps in the literature is that no study has examined whether HIV-free survival differs between HIV-exposed infants who appropriately avoid all breastfeeding, and breastfeeding HIV-exposed infants who receive postnatal prophylaxis to reduce postnatal transmission. This work still has to be done.

While regimens to minimise postnatal HIV transmission are still being finalised (particularly in the public sector), health care providers and mothers need to be supported so that current feeding recommendations maximise HIV-free survival. These recommendations are explained in the next section.

CURRENT INTERNATIONAL AND NATIONAL FEEDING RECOMMENDATIONS, AND THE BASIS THEREOF

In 2005 the Lancet Child Survival series showed that universal coverage with EBF for 6 months and continued breastfeeding – i.e. breastmilk and complementary foods – up to 1 year may prevent 13% of under-5 deaths globally, even in the presence of HIV.[21]

Subsequently the Lancet Nutrition series showed that in the first 6 months of life EBF has far greater child survival benefits compared with predominant breastfeeding (feeding breastmilk and non-nutritive liquids), partial breastfeeding and not breastfeeding for all-cause mortality (odds ratio (OR) 1.48 (95% confidence interval (CI) 1.13 - 1.92), OR 2.85 (95% CI 1.59 - 5.10), OR 14.40 (95% CI 6.09 - 34.05), respectively), diarrhoea mortality (OR 2.28 (95% CI 0.85 - 6.11), OR 4.62 (95% CI 1.81 - 11.77), OR 10.53 (95% CI 2.80 - 39.64)) and pneumonia mortality (OR 1.75 (95% CI 0.48 - 6.43), OR 2.49 (95% CI 1.03 - 6.04), OR 15.13 (95% CI 0.61 - 373.84)) in resource-limited settings.[22]

Despite these benefits of EBF, research highlighted in Table I also shows that any breastfeeding (including EBF) carries a risk of postnatal HIV transmission, which is largest for mixed feeding and smallest for EBF.[23-26] HIV infection therefore presents new challenges for infant feeding, which have often been explained as two sides of a scale – one side is weighed down by the risk of HIV transmission through breastfeeding, and the other is weighed down by the risk of morbidity and mortality from common childhood illnesses as a result of not breastfeeding. This risk of mortality as a result of not breastfeeding has been documented among HIV-exposed infants in numerous sub-Saharan settings, including South Africa.[23, 27-30]

Furthermore, Doherty *et al.* show that inappropriate decisions to formula feed and inappropriate decisions to breastfeed were associated with an increased hazard of HIV or death compared with appropriate decisions to formula feed (adjusted hazard ratio (HR) 3.63 (95% CI 1.48 - 8.89) and 3.35 (95% CI 1.25 - 8.96) compared with 1, respectively).[31]

CURRENT RECOMMENDATIONS

In an attempt to be pragmatic, to minimise breastmilk transmission of HIV and maximise HIV-free survival, the World Health Organization (WHO), UNICEF and Inter-agency Task Team (IATT) recommended between 2006 and November 2009 that feeding decisions in HIV-positive women should depend on the mother's health status, the local situation, the health services available and the counselling support she is likely to receive.[32] Until 30 November 2009 the IATT recommended that EBF for 6 months should be instituted unless replacement feeding (avoiding breastmilk) is **A**cceptable, **F**easible, **A**ffordable, **S**ustainable and **S**afe (commonly referred to as the AFASS criteria). At 6 months, if replacement feeding is still not AFASS, continuation of breastfeeding with additional complementary foods is recommended. All breastfeeding in HIV-positive women should stop once a nutritionally adequate and safe diet without breastmilk can be provided. On 30 November 2009, the WHO released revised rapid guidance on HIV and infant feeding (available from http://www.who.int/child_adolescent_health/documents/9789241598873/en/index.html). These state, *inter alia*, that mothers known to be HIV infected (and whose infants are HIV uninfected or of unknown HIV status) should exclusively breastfeed their infants for the first 6 months of life, introducing appropriate complementary foods thereafter, and continue breastfeeding for the first 12 months of life.

Breastfeeding should then only stop once a nutritionally adequate and safe diet without breastmilk can be provided. Mothers known to be HIV infected who decide to stop breastfeeding at any time should stop gradually within 1 month. Mothers or infants who have been receiving ARV prophylaxis should continue prophylaxis for 1 week after breastfeeding is fully stopped. Stopping breastfeeding abruptly is not advisable. Mothers known to be HIV infected should only give commercial infant formula milk as a replacement feed to their HIV-uninfected infants or infants who are of unknown HIV status, when specific conditions are met (referred to as AFASS – affordable, feasible, acceptable, sustainable and safe – in the 2006 WHO recommendations on HIV and Infant Feeding).

While the IATT 2006 - 2009 recommendations have been accepted by most resource-limited countries, countries still need to discuss the 2009 revisions and then amend their policies. Fig. 1 lists the current South African PMTCT guidelines on infant feeding in the context of HIV.[33] These are similar to the guidelines followed in many resource-limited countries.

Fig. 1. Current (2008) South African PMTCT feeding recommendations.[33]

The IATT 2006 - 2009 recommendations need to be implemented while countries finalise their new policies on postnatal prophylaxis and infant feeding. Although new policies – which will stem from recent evidence (Table I) and the WHO rapid guidance – still need to be debated and finalised, aspects of the IATT 2006 - 2009 recommendations on infant feeding and HIV will still be relevant henceforth. For example, if women meet the AFASS criteria they should still be advised not to breastfeed so that postnatal HIV transmission is eliminated; if women do not meet the AFASS criteria then the new policy may advise breastfeeding for 6 months with an ARV regimen that continues throughout the breastfeeding period. From a child survival perspective EBF has been recommended for mothers who do not meet the AFASS criteria. However, in most African settings EBF is not a normative cultural practice in the absence of intense support. Ghuman *et al.* showed that the EBF rate among women of unknown HIV status – living in a high-HIV prevalence area – was 18% at 14 weeks,[10] and Goga *et al.* showed that only 18% of HIV-positive breastfeeding women practised EBF at 12 weeks in a PMTCT programme setting.[11] Bland *et al.* (the

Vertical Transmission Study) were able to increase EBF rates to 40% at 6 months following an intense peer counselling intervention comprising approximately 20 home-based visits starting antenatally (4 visits) until 6 months after delivery.[12] However, it is questionable whether this intervention is replicable in a programmatic setting. More recently a pooled analysis of data from the Vertical Transmission Study (South Africa) and Ditrame Plus Study (Cote d'Ivoire) showed that postnatal HIV transmission rates were not significantly different among infants who had been exclusively breastfed or predominantly breastfed for the same time period; however, infants exposed to solids at least once during the first 2 months of life were 2.9 (95% CI 1.1 - 8.0) times more likely to become HIV infected postnatally compared with infants who had never received solids this early.[34] This analysis did not compare HIV-free survival among predominantly or exclusively breastfed infants, but it does suggest that if EBF is not socially or culturally feasible among breastfeeding HIV-positive mothers, the next best option is predominant breastfeeding. Mixed feeding with the early introduction of solids is the most risky for transmission.

The following section provides recommendations on how to implement feeding recommendations that assess the appropriateness of feeding options (AFASS), as this has been a stumbling block. It also suggests how safe (exclusive or predominant) infant feeding can be supported.

HOW TO IMPLEMENT THE FEEDING RECOMMENDATIONS

In view of recent data highlighting the risks of inappropriate feeding choices with regard to HIV-free survival,[31] much attention needs to be given to how HIV-positive women make their feeding choices. To assess AFASS a checklist can be used (Table II). If there is any 'No' in the 'EBF for 6 months' column, advise the mother to exclusively breastfeed for 6 months. If all responses are 'Yes', advise her to avoid all breastfeeding.

In a recent review of solutions to operational challenges in PMTCT,[35] a novel '5-finger approach' to assess AFASS and facilitate appropriate infant feeding choices has been described by Coutsoudis and Kroon. An example of the 5-finger approach, which is based on current literature,[31] is illustrated in Fig. 2 and can be used by doctors, nurses and lay counsellors. Fig. 2 is in the process of being revised by Coutsoudis and Kroon so that the 'Breast is Best' logo is not so prominent. Readers interested in using Fig. 2 should contact Coutsoudis and Kroon for updated versions.

Regardless of the method used to assess AFASS, appropriate infant feeding choices should be encouraged to maximise child survival in the context of PMTCT.

TABLE II. ASSESSING AFASS CRITERIA		
	Most suitable feeding option	
Questions that can be used to assess AFASS	**EBF for 6 months if NO to ANY of these questions**	**Avoiding all breastfeeding: Exclusive formula feeding for 6 months if YES TO ALL of these questions**
Can the mother avoid all breastfeeding in her current social and cultural context?	NO	YES
Does the family/person the woman stays with know that she is HIV positive?	NO	YES
Can the woman overcome or deal with any stigma or discrimination if she were to choose to avoid all breastfeeding?	NO	YES
Will the woman be able to go to the clinic to collect formula milk regularly?	NO	YES
Will the woman have money for transport to collect milk or to buy milk if the supply runs out or to take the infant to a clinic if he/she gets diarrhoea?	NO	YES
Does the woman or caregiver have enough time, knowledge, skills, resources and support to correctly prepare breastmilk substitutes?	NO	YES
Will the woman be able to prepare night feeds easily?	NO	YES
Is the mother able to feed the infant 8 - 12 times in 24 hours?	NO	YES
Will the woman be able to regularly buy utensils needed to prepare formula milk?	NO	YES
Will the woman be able to get a continuous, uninterrupted supply of formula milk AND water AND fuel?	NO	YES
Is there piped water in the house or yard that can be accessed regularly?	NO	YES
Will the woman be able to wash her hands before preparing each feed and prepare each feed with boiled water and clean utensils?	NO	YES
Will the woman be able to store formula milk correctly and hygienically?	NO	YES

Lastly, the acronym SSSUPPORT (Table III) should be taught or displayed in all health facilities to remind health workers about their responsibilities towards optimising child survival through appropriate infant feeding counselling in the context of HIV.

SUMMARY AND CONCLUSIONS

Postnatal maternal or infant ARV regimens reduce postnatal HIV transmission through breastmilk. Maternal postnatal regimens appear as efficacious as infant postnatal regimens; however, data suggest that there may be a trend favouring infant nevirapine over maternal HAART (both used from 1 week to 6 months after delivery). The protective effect of regimens stops once the regimens stop, if breastfeeding continues. Any of the new regimens should be implemented among breastfeeding HIV-positive mothers without further delay where the human resource, financial and socio-cultural capacity exists to do this, e.g. in private sector facilities, despite the inherent inequity in this approach.

For resource-limited public health settings three main issues need to be considered when deciding on which ARV regimen to include in a national policy: (*i*) the basic science: efficacy and possible effectiveness of various postnatal prophylactic regimens using HIV transmission and HIV-free survival as the main outcomes; (*ii*) the feasibility of each regimen, from a user perspective; and (*iii*) the feasibility of each regimen from a health system/service perspective. Work needs to be undertaken urgently to examine these issues.

While stakeholders engage in discussions about which is the best regimen to include in national policy on minimising postnatal transmission, **SSSUPPORT** should be given to all HIV-positive women to improve infant outcomes and reduce postnatal transmission: **S**creen all women for HIV; **S**end off CD4 cell counts on all HIV-positive women; **S**creen all HIV-positive women for AFASS using a standardised tool (e.g. Table II/Fig. 2); **U**nderstand the woman's personal and socio-cultural context; **P**romote exclusive or predominant breastfeeding if all AFASS criteria are not met; **P**romote exclusive

Fig. 2. A 5-finger method of assessing AFASS criteria developed by Anna Coutsoudis and colleagues (Department of Paediatrics and Child Health, UKZN) and Max Kroon, Mowbray Maternity Hospital, Western Cape. Note that this 5-finger approach is evolving, and is being amended to reduce the size of the 'Breast is Best' caption and text. Readers should contact Coutsoudis and Kroon for updated versions.

formula feeding if all AFASS criteria are met; **O**rganise supplies of formula milk and co-trimoxazole; **R**eview mothers and infants in the first 3 days after delivery, in the first 2 weeks postnatally and monthly thereafter, and review health and feeding practices, regardless of feeding choice, at every visit; and lastly **T**reat all pregnant women with HAART if they meet national criteria for HAART initiation.

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TABLE III. KEY MESSAGE TO PROMOTE SAFE INFANT FEEDING AND IMPROVE HIV-FREE SURVIVAL

Support	Without prophylaxis to reduce postnatal transmission through breastmilk	Additional steps if prophylaxis to reduce postnatal HIV transmission through breastmilk becomes policy
S S S	Screen all women for HIV Send off CD4 cell counts on all HIV-positive women Screen all HIV-positive women for AFASS	
U	Understand the mother's personal and socio-cultural context	
P	Promote exclusive or predominant breastfeeding if all the AFASS criteria are not met	PLUS start postnatal prophylactic regimens to minimise postnatal HIV transmission
P	Promote exclusive formula feeding if all the AFASS criteria are met	
O	Organise supplies: of formula milk if mothers meet AFASS and choose to formula feed of co-trimoxazole for infants from 6 weeks	PLUS supplies: of prophylactic antiretrovirals if mothers do not meet AFASS
R	Review mothers and infants in the first 3 days post-natally, in the first 2 weeks postnatally and monthly thereafter Review mother's and infant's health, and infant feeding practices/techniques, regardless of feeding choice	PLUS adherence to any regimens
T	Treat all mothers and children with antiretroviral therapy according to updated recommendations	

Adapted from Goga *et al.*[11] and Jackson *et al.*[42]

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